MINNOW POPULATION OF GRIMES CREEK AND THEIR RESPONSES TO STREAM POLLUTION

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A Field Report

Presented to

The Graduate Division

Drake University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

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by

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August 1961

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Approved by Committee:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (continued)

CHAPTER I

As the population of the state grows the demand for the natural resources of the state increases. With the increased demand for and use of resources the natural environments of many living creatures are destroyed or changed so that they are not suitable for maintainance of life. In some cases this change is not rapid but, over a period of years it is found that many species have diminished in number or have disappeared from their former habitats.

This change of population is true of the minnow popuation in Iowa.[1] Minnow populations of Iowa streams have changed due to the many environmental conditions they encounter from year to year. Some of the factors affecting the minnow population are the available food supply, water level, turbidity and pollution.

Previous investigations of minnow populations have generally been made in the larger streams of Iowa. It has been the purpose of this study to investigate a small creek minnow population and to study its response to stream pollution by a corn processing plant located near Grimes, Iowa. There are

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[1] James R. Harlan., and Everett B. Speaker, Iowa Fish and Fishing (Des Moines: State of Iowa, 1956), p. 84.

many smaller streams and creeks in Iowa which, with intensive study, can furnish needed information on the minnow population, and be important links to the understanding of aquatic life of inland streams.

CHAPTER II

REVIEW OF THE LITERATURE

The importance of minnows as forage for game fish has long been known. The minnow also serves as a control against several aquatic insects. As live bait, minnows are in demand for many game fish anglers.

David S. Jordan and Seth Meek[1] were interested in the fish of Iowa and in 1885 published the first recorded data on Iowa fish. Their early records have been useful. Many species recognized at that time have now disappeared from the list of Iowa fish.

Other investigations of Iowa fish have been made since those of Jordan and Meek, but few have made special reference to the minnows until William C. Starrett[2] published on the fish of Boone county. Starrett not only studied the distribution of minnows in Boone county, but also their abuandance.

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[1] David S. Jordan and Seth E. Meek. "List of Fish Collected in Iowa and Missouri in August 1884, with the Description of Three New Species," Proc. U.S. National Museum, VIII (1885) 1-13.

[2] William C. Starrett. "Distribution of the Fishes of Boone County, Iowa, With Special Reference to the Minnows and Darters," The American Midland Naturalist, XXXXIII (January, 1950), 111.

Starrett[1] concluded that floods and silt appear to be important factors in the changing abundance of minnows in the Des Moines River, in Boone County, Iowa.

In 1958, Andreas A. Paloumpis[2] studied the responses of minnows in Squaw Creek, which is approximately 40 miles long and up to 20 or 30 feet in width. He found that most species of minnows maintained themselves in the stream even when subjected to drastic conditions of flooding or drought.

Although much has been learned about minnows in river and stream habitats from the recent studies of minnows, little has been published on the smaller streams under 10 feet in width. As they become shallow in late summer and fall, smaller streams possess great potential as suppliers of minnows to larger streams.

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[1] William C. Starrett, "Some Factors Affecting the Abundance of Minnows in the Des Moines River, Iowa," Ecology, XXXII (January, 1951), 23.

[2] Andreas A. Paloumpis, "Responses of Some Minnows to Flood and Drought Conditions in An Intermittent Stream," Iowa State College Journal of Science, XXXII (November, 1958), 547.

CHAPTER III

METHODS AND MATERIALS

The Grimes creek area, Figure 1, north of the town of Grimes, Iowa, is comprised of four small tributaries feeding into a larger creek, which in places attains the width of eight feet. Two of the small tributary creeks enter into the larger creek at its lower end before it empties into Beaver Creek. The two headwater creeks start in field areas from drainage tile. Much of their course is through pasture land and occasional groves of trees. In section 29 of Jefferson Township the headwater creeks merge to form the major creek that I will refer to as Grimes creek. The two headwater creeks are fast flowing, narrow, streams with shifting sand beds and occasional pools formed by logs or other debris. These headwater creeks fluctuate greatly in their water level due to the rapid run-off rate. Generally the water levels are low and no minnows are present.

The Grimes creek area is located in land that is hilly, and in some areas distinct terminal moraines are visible. Because of its high elevation this land gives its streams great velocity as compared to the level land streams.

Approximately one mile after the convergence of the two headwater streams, see Figure 1 letter A, minnows appear.

In this area the stream has cut its way into shale and limestone bedrock. Small springs empty into the creek from the sides of hills. Numerous pools are present in this part of the creek and are separated by limestone rubble that creates small rapids between pools.

Five collecting stations were established along the main creek at approximately equal distances apart. Station number 1 was located in the limestone pool area of the creek in the middle of section 29 of Jefferson Township. Water depth in some of the pools at this point was about thirty inches.

Station number 2 was located below station 1. Its location is between section 28 and 29 of Jefferson Township. In this area the creek is still in pools separated by limestone rubble, but the bottom composition varies from shifting sand to gravel and limestone rubble. Water depth varies, reaching 20 inches in pool areas.

Station number 3 was located below station 2 between section 27 and 28 of Jefferson Township. The creek in this area has reached lower elevation and is in the area of pasture and crop land. The creek bottom is almost entirely shifting sand, with occasional limestone and rock rubble in local areas. No large pool areas are present in this lower section of the stream. Stream depth varies in depth with a maximum of ten inches.

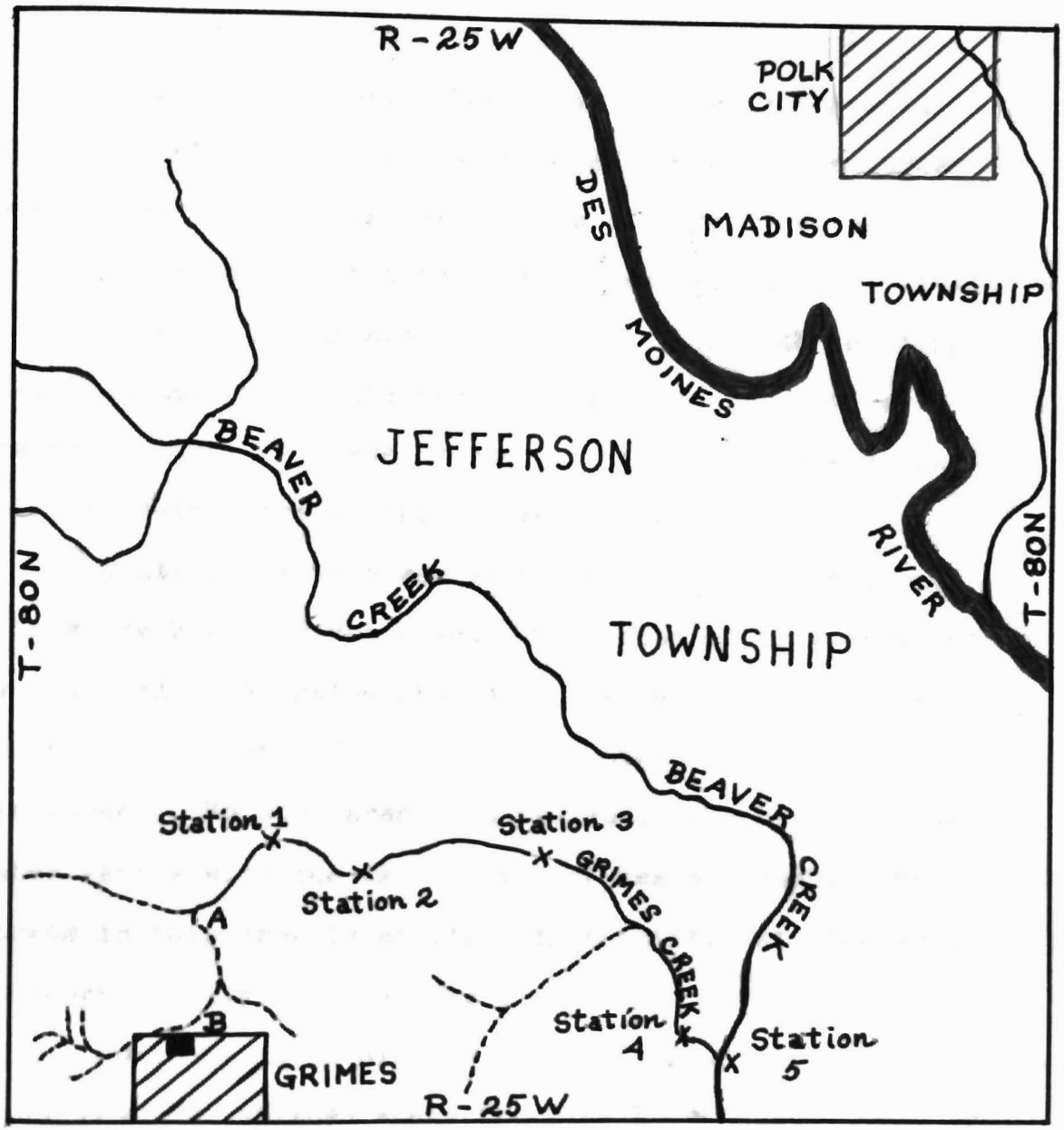

Figure 1.* Grimes Creek area located in Jefferson Township, Polk County, Iowa.

* Map., Supervisors Districts (1-5), Polk County, Iowa.

Station number 4 was located between section 34 and 35 of Jefferson Township. In this area the creek passes through low pasture land. The creek bottom is composed mainly of shifting sand. The average depth of the stream is approximately six inches. Above station 4 two small tributary streams have entered the creek adding additionsl water. These streams are small and shallow with shifting sand bottoms. They have their origin from field tile, so the water level in these creeks is low. Minnows are found only at their entrance into Grimes creek.

Station number 5 was established at the confluence of Grimes creek and Beaver creek. This station is approximately two hundred yards below station number 4. The water depth, in this lower part of the creek, is approximately four to six inches. No pool areas are present. The depth of the water varies with the water level of Beaver creek. The stream in this area is at its widest point. At high water it reaches a width of ten feet.

Collections of minnows were made from all five stations every week for sixteen weeks from the 13 of August 1960 to the 26th of November 1960. Fish were identified by examining their external and internal anatomy. Identification keys used were from the Iowa Fish and Fishing book.[1] One seine haul

[1]James R. Harlan., and Everett B. Speaker, op. cit. pp. 355-370.

of a 4x10x1/8 common minnow seine was made at each station and the minnows taken were preserved in a formalin solution for later identification. Field notes on water depth, stream velocity, width, water temperature, air temperature, depth of collection and condition of stream bottom were taken.

CHAPTER IV

RESULTS AND INTERPRETATION OF DATA

A total of 2006 minnows were collected, identified, measured and examined from the five stations. The data on the percentage of the total number of six major species collected are summarized in Figure 1. The bigmouth shiner (Notropis dorsalis, Agassiz) made up 38% of the total number collected. This species is the most widely distributed and abundant minnow in the state of Iowa. The creek chub (Semotilus atromaculatus, Mitchill) compose 24% of the total number of minnows collected. This chub is common in most of the smaller streams of Iowa. The sand shiner (Notropis deliciosus, Girard) accounted for 14% of the total number of minnows collected. This minnow is quite common and at times difficult to identify because of the intergrading with the western sand shiner (Notropis missuriensis, Cope). The spotfin shiner (Notropis spilopterous, Cope) comprised 13% of the total number of minnows collected. This species of shiner is quite common in shallow, swift water. The bluntnose minnow (Pimephales notatus, Rafinesque) made up 6% of the total number of minnows collected. This minnow is widely distributed in Iowa and abundant in many streams. The fathead minnow (Pimephales promelas, Rafinesque) compose 5% of the total

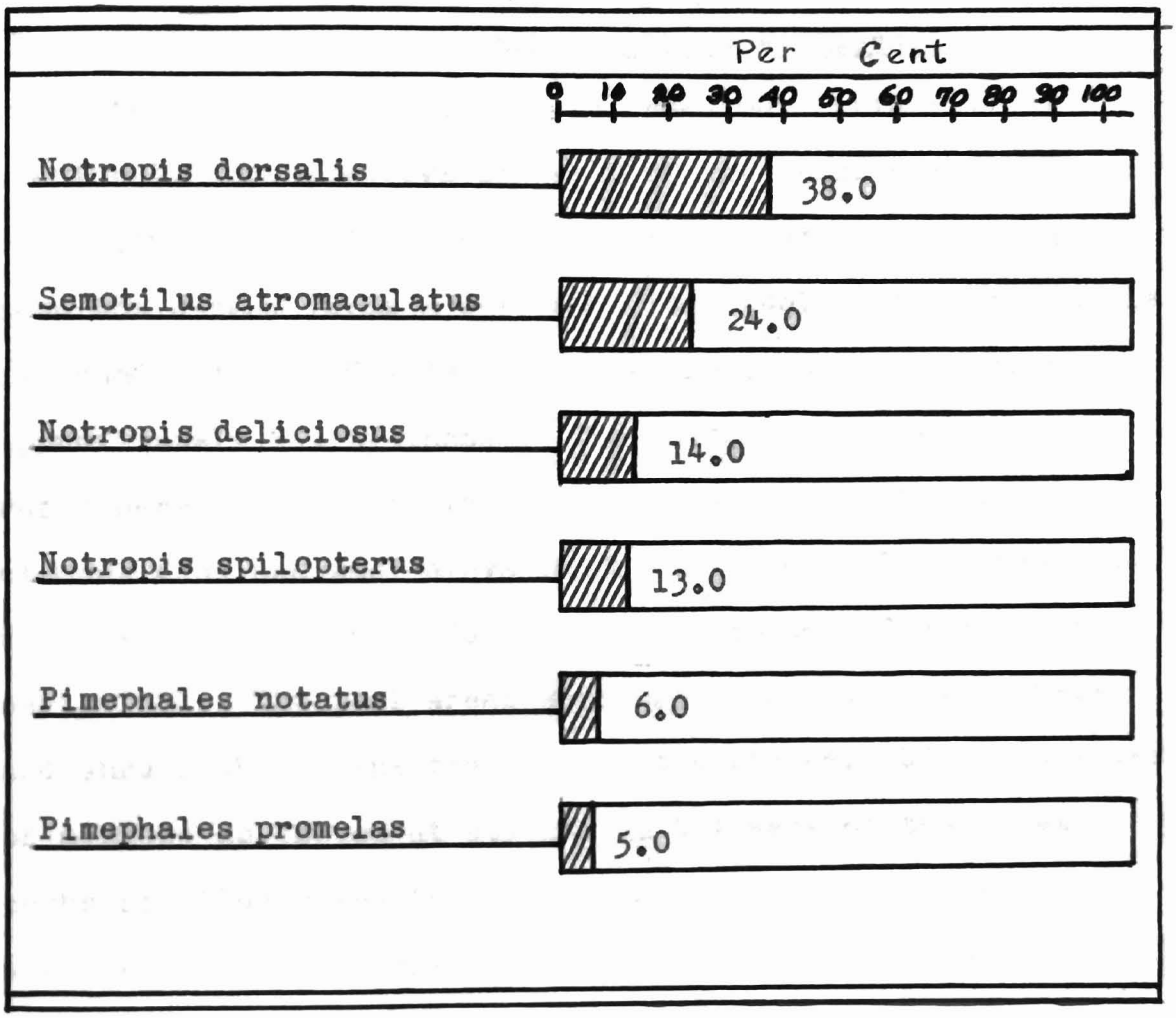

Figure 2. Percentages of the total number of six major species of minnows collected.

number of minnows collected. This minnow is abundant in lakes, ponds and streams of Iowa.

Of the 548 creek chubs collected, only 12 were adults. The remaining were found to be young of the present year. (Spring 1960) The creek chub (Semotilus atromaculatus), as indicated in Figure 2 A, page 13, was found primarily at station 1. Seventy-five per cent of the total number of creek chubs collected were found at this station. In this area the stream forms a series of long pools with rock rubble and sand bottom. The depth of some pools was found to be approximately thirty inches. The velocity of the stream is rapid here. Over a twelve inch drop was found in some instances from one pool elevation to the other. This area provided storage of water during the dry months of summer and early fall. The pool areas were often shaded by the trees and shrubs which line the path of the stream. Of all species of minnows collected at station 1, 83% were of the creek chubs as illustrated in Figure 2 B, page 13. The creek chub was the dominant species. This headwater area at station 1 evidently provides an excellent habitat for this minnow. At station number 2, as indicated in Figure 2 A page 13, 15.3% of the 548 creek chubs collected were found. The young chubs seem to have a tendency to stay in the area where they were spawned until late fall, when they appear to move out with

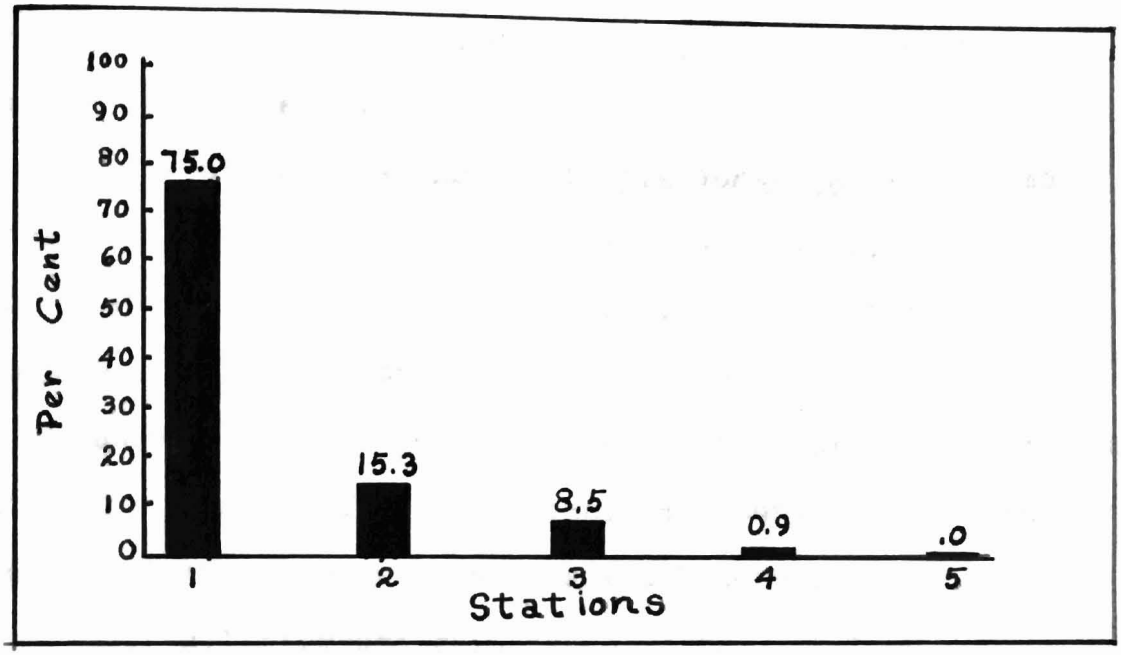

Figure 3 A. Percentage of all Semotilus atromaculatus collected according to station.

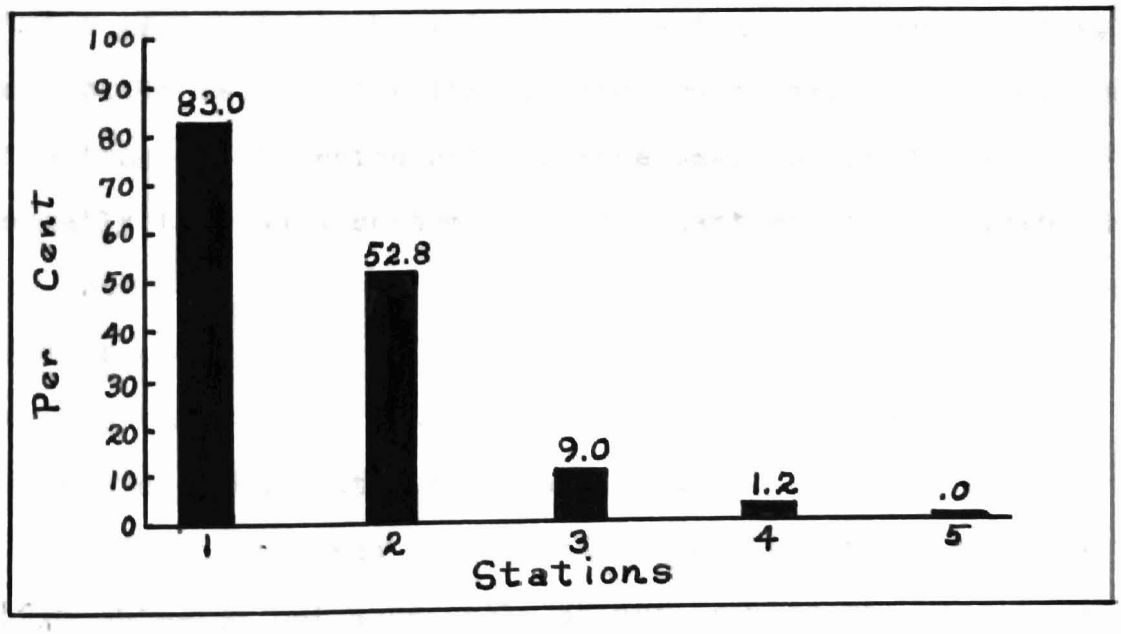

Figure 3 B. Percentage of total minnows collected at each station that were of the species, Semotilus atromaculatus.

the waters from fall rains. The decline of chubs from station 1 to station 5 is very rapid, as illustrated in Figure 2 A, page 13.

The bigmouth shiner (Notropis dorsalis) is the most widely distributed and abundant minnow in Iowa. It was found at all collecting stations. In his collections in Boone County, Starrett[1] found that the bigmouth shiner was most abundant in the smaller creeks and became less numerous with the increase in stream size. He found this species to be one of the three most abundant collected.

Of all bigmouth shiners collected, station 3 produced 50%, see Figure 3 A, page 16. Station 3 apparently provided adequate requirements for this species. In this area the stream is normally about 6 feet in width and flows rapidly. The bottom is almost entirely sand and gravel, with occasional limestone rubble which creates some small pools or rapids. Normally this sand bottom is in constant movement, except in the late fall when the velocity of the stream slows, and the sand is not carried by the water. The water depth at this station varies from 6 to 10 inches, with some deeper pools where the stream cuts into the banks.

Stations 4 and 5 also had large populations of bigmouth shiners, but apparently do not provide the ideal conditions that were at station 3. At stations 4 and 5 the

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[1] Starrett, op. cit., pp. 112-127.

stream depth is from four to six inches. The stream in this area is much straighter in its course, and there are fewer pools and riffles. The writer has observed many minnows in this stream from the bank, and it seems that most prefer a habitat that allows them to seek shelter in pools when they are disturbed.

As shown Figure 3 B, page 16, of all the minnows collected at station 3, 67% were bigmouth shiners. This was the dominant species at this station and was also quite common at stations 2, 4, and 5. The bigmouth shiners ability to utilize shallow, sandy, water areas that other minnows will not use, apparently helps to account for its dominance in Grimes creek.

The sand shiner, (Notropis deliciosus), was found in small numbers at most of the collecting stations except station 4. As shown in Figure 4A, page 18, of all sand shiners collected 58.6% were found in the station 4 area. At this station the sand shiner was found in company with the spotfin shiner and the bigmouth shiner. Station 4 is within a quarter mile of Beaver Creek. Minnows were observed moving great distances in the creek when frightened. Undoubtedly, many minnows move into Grimes creek to stations 4 and 5 and return to Beaver Creek making an accurate species count impossible at specific stations. It would appear the sand shiner does

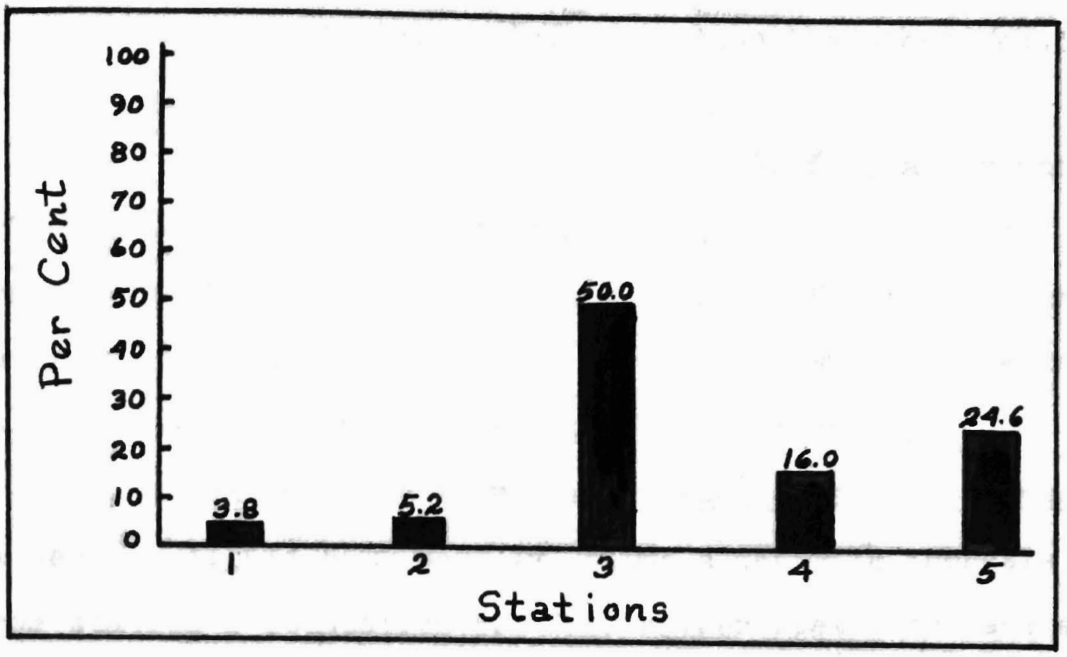

Figure 4 A. Percentage of all Notropis dorsalis collected according to station.

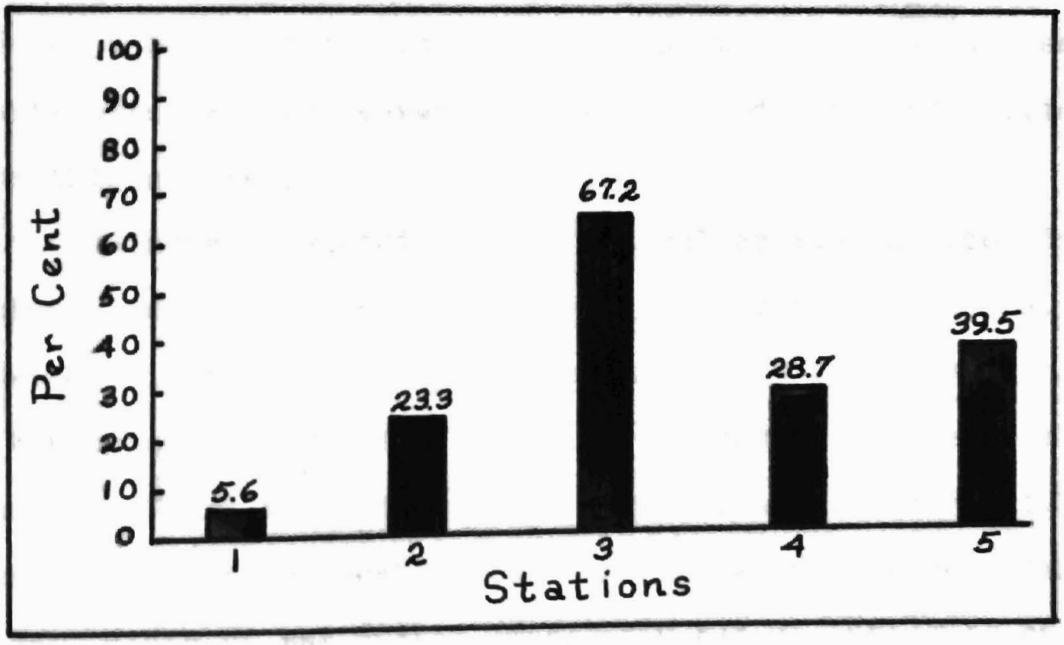

Figure 4 B. Percentage of total minnows collected at each station that were of the species, Notropis dorsalis.

utilize the area at station four more than the other species of minnows.

As shown in Figure 4 B, page 18, 38.9% of all minnows collected at station number four were sand shiners. The headwaters of Grimes Creek, with the pools of water, apparently are not attractive to the sand shiner whose presence is in the shallow, sandy water of the lower creek.

The number of spotfin shiners (Notropis spilopterus) as seen in Figure 5 A, page 19, shows a definite increase from station 1 to station 5. This shiner seemed to have a preference for shallow sandy bars and the riffles just beyond them in the swift current. Of all spotfin shiners collected 40% were found at station 5 where Grimes creek flows into Beaver Creek. At the mouth area of Grimes creek a huge sand delta extends into Beaver Creek and provides a good habitat for this species.

Starrett[1] stated that in his collections no spotfin shiners were found in streams less than 10 feet in width. However, in this study spotfin shiners were found from station 1 throughout the creek. From observations on Grimes creek it has been found that the spotfin requires water with a high velocity and is generally found in riffle areas around sand bars. Width of the stream apparently had no influence on the

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[1]Starrett, op. cit., pp. 116-117.

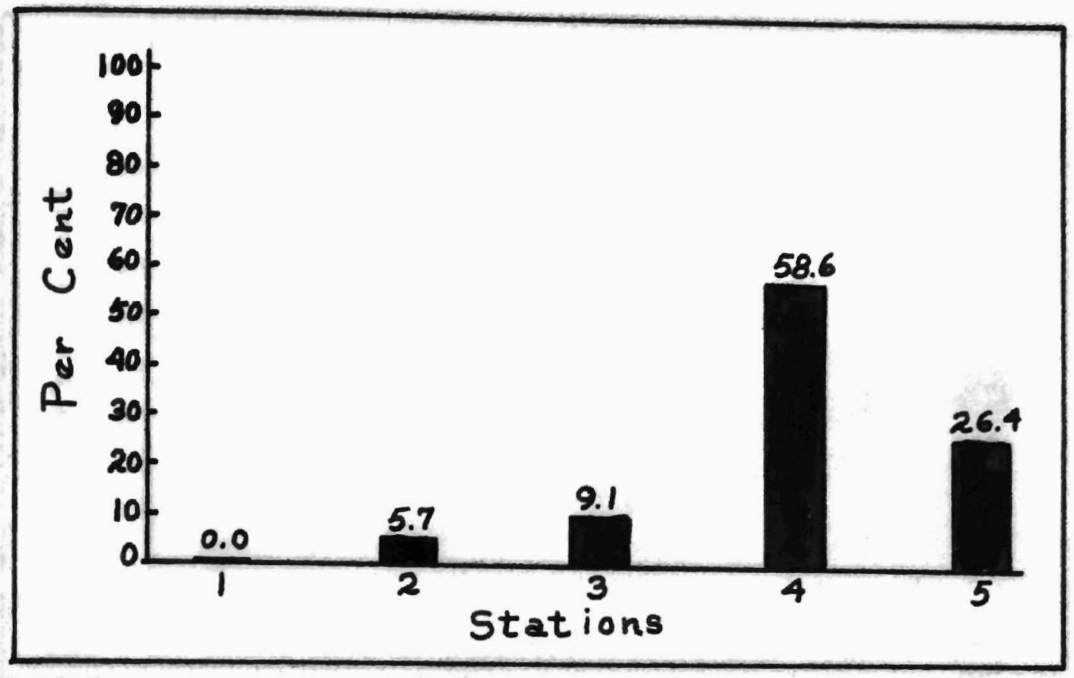

Figure 5 A. Percentage of all Notropis deliciosus collected according to station.

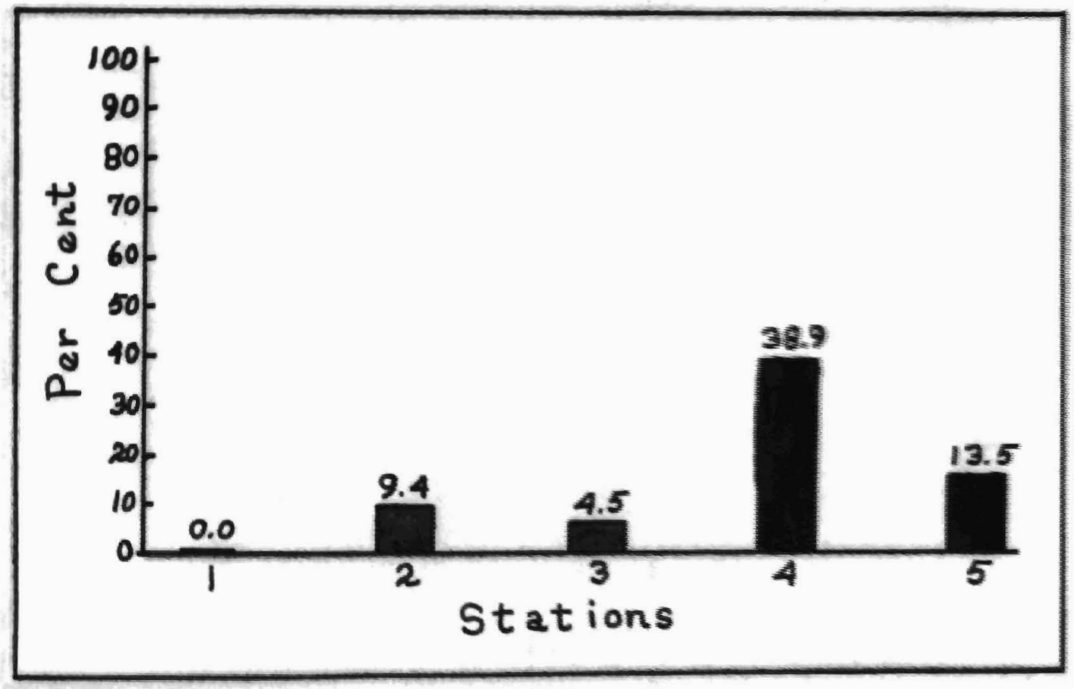

Figure 5 B. Percentage of total minnows collected at each station that were of the species, Notropis deliciousus.

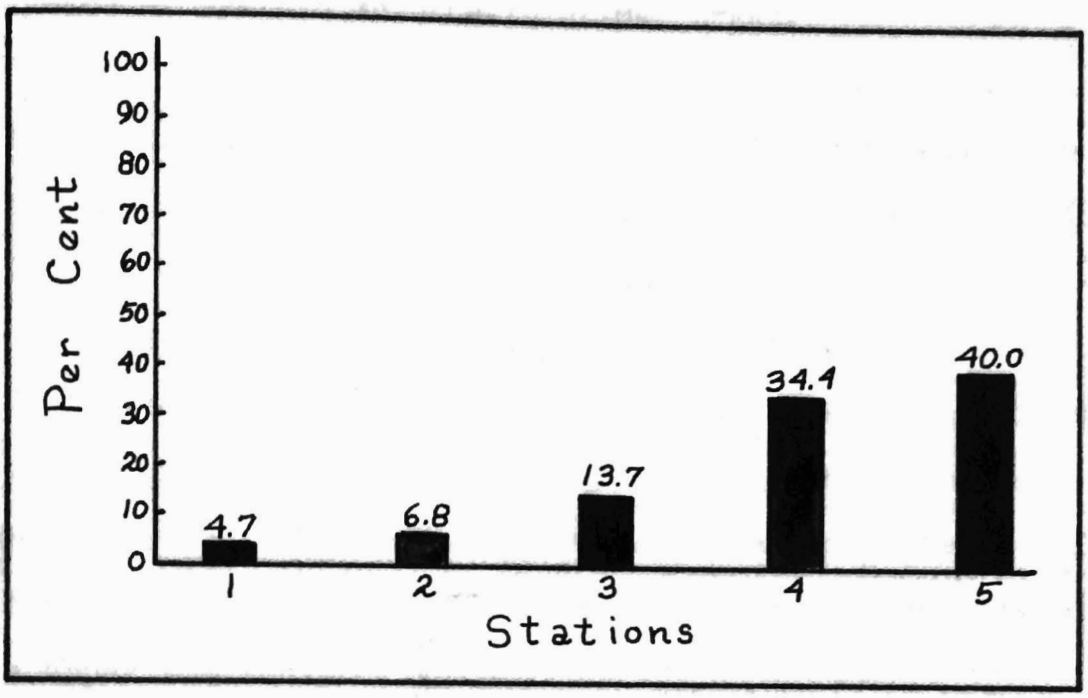

Figure 6 A. Percentage of all Notropis spilopterus collected according to station.

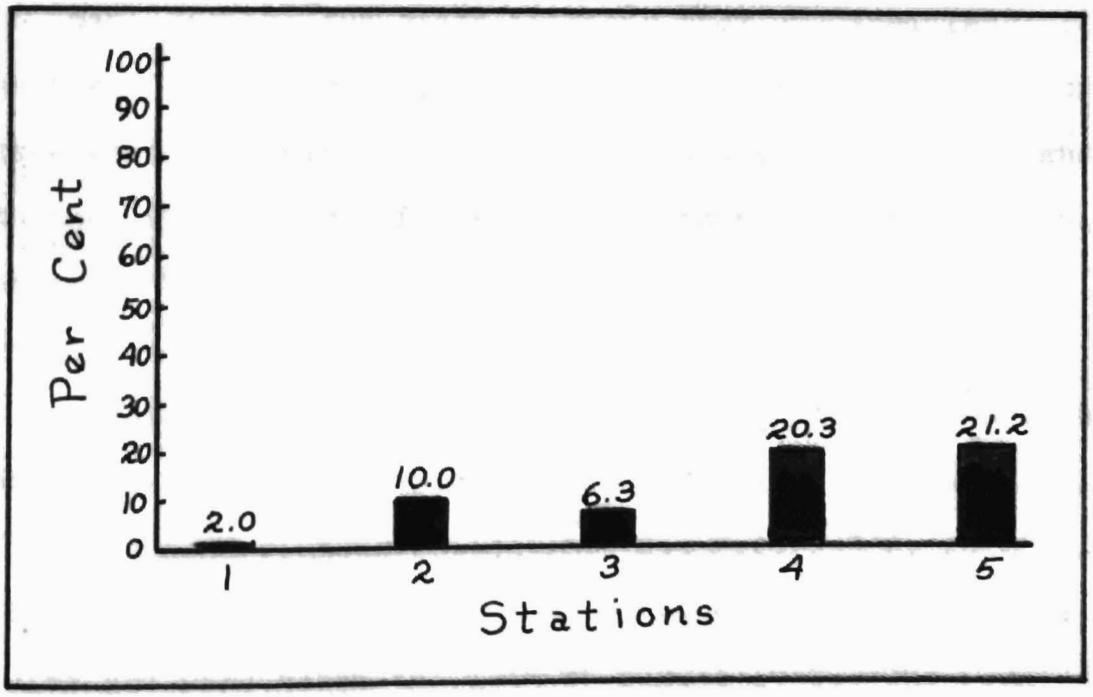

Figure 6 B. Percentage of total minnows collected at each station that were of the species, Notropis spilopterus.

presence of spotfin shiners in Grimes creek.

As shown in figure 5 B, approximately 20% of the minnows collected were spotfin shiners. The sand and gravel bottom of the stream and velocity of the water in this area seemed to provide a suitable environment for this species.

The bluntnose minnow (Pimephales notatus) was found at all stations. As shown in Figure 6 A, page 19, stations 3, 4, 5, produced 85% of the total number of bluntnose minnows collected. This species seemed to have a perference for wider regions of the creek and did not appear frequently at the upper stations.

The bluntnose minnows at station 5 made up only 11.4% of the total minnows collected at that station. See Figure 6 B, page 21. At the other stations they appeared less frequently. At stations 1, 2, and 3 only adults were taken and these were collected only during a two week period in August. Internal examination of these adults revealed several gravid females. The upper portions of Grimes creek is apparently used by the bluntnose minnow for spawning purpose.

The fathead minnow (Pimephales promelas) was rare in most collections from Grimes creek. Station 3 produced 37.3% of all fathead minnows collected. See Figure 7 A, page 22. The fathead minnows collected at stations 1, 2, and 3 were adults and were taken the 13th of August 1960. The females were examined and found to contain many eggs. The males had

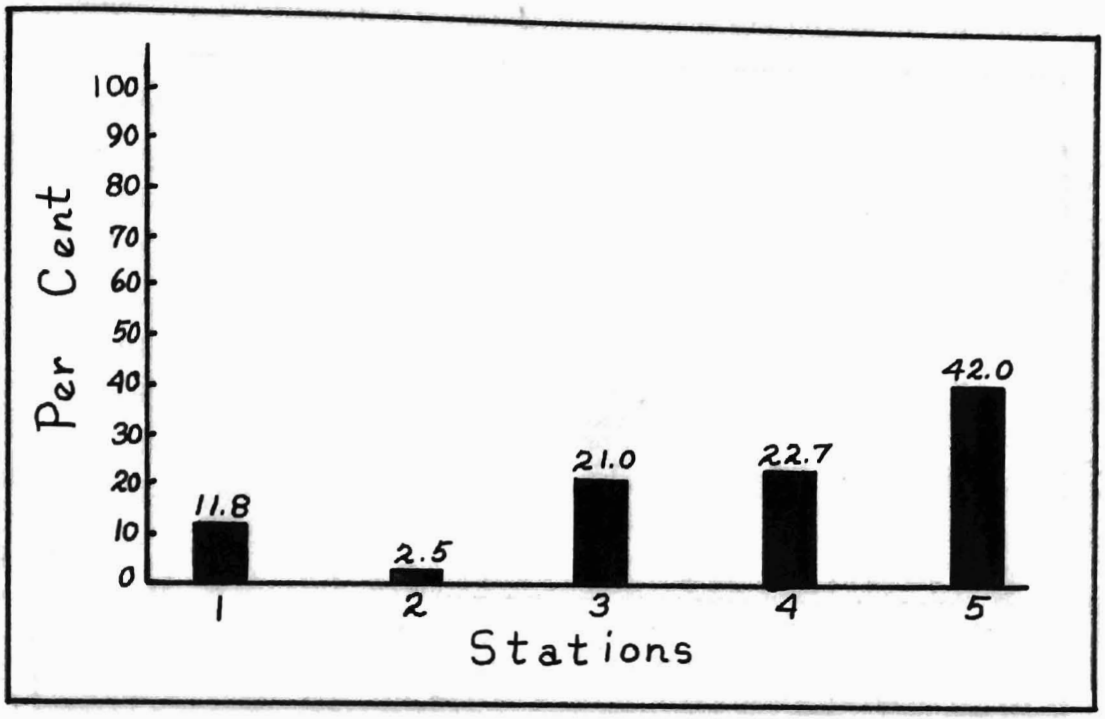

Figure 7 A. Percentage of all Pimephales notatus collected according to station.

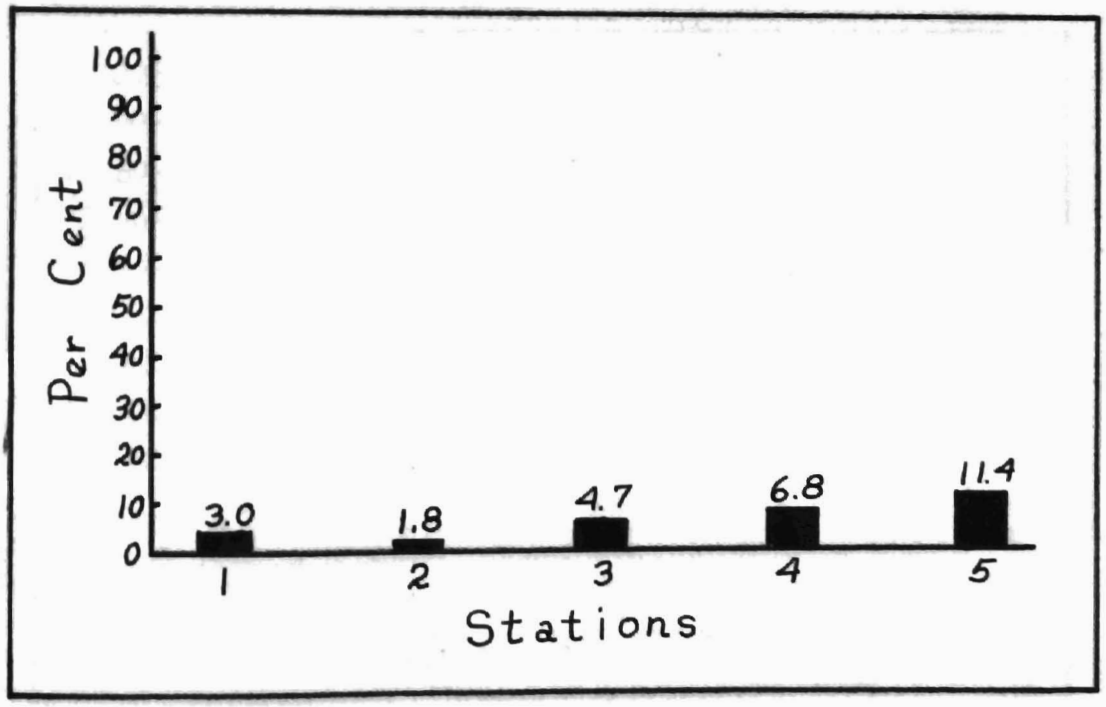

Figure 7 B. Percentage of total minnows collected at each station that were of the species, Pimephales notatus.

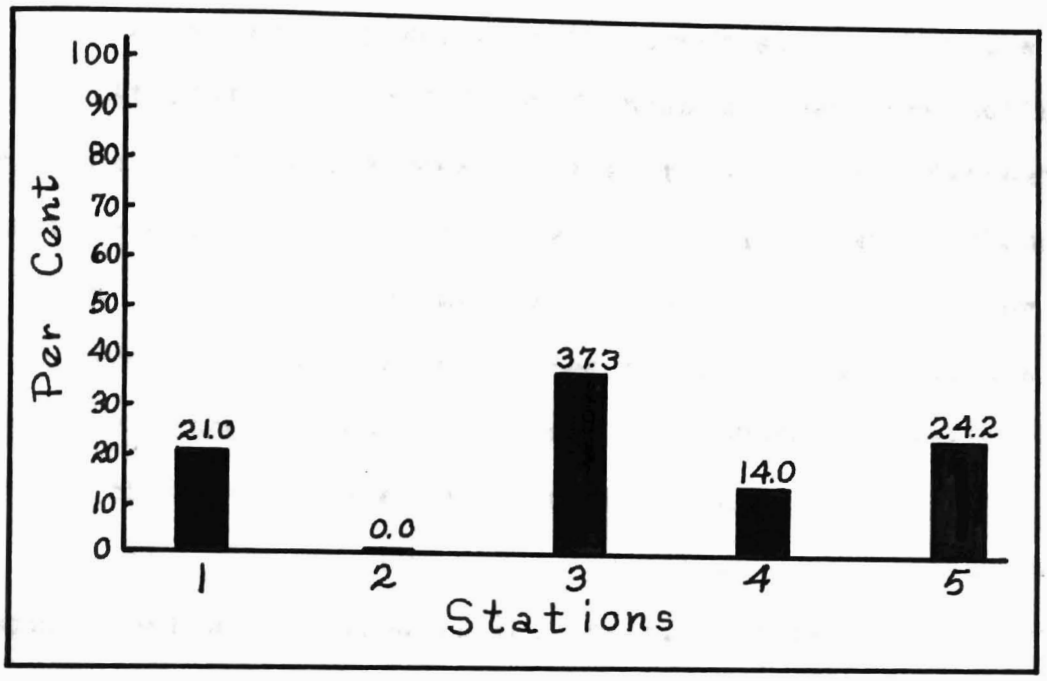

Figure 8 A. Percentage of all Pimephales promelas collected according to station.

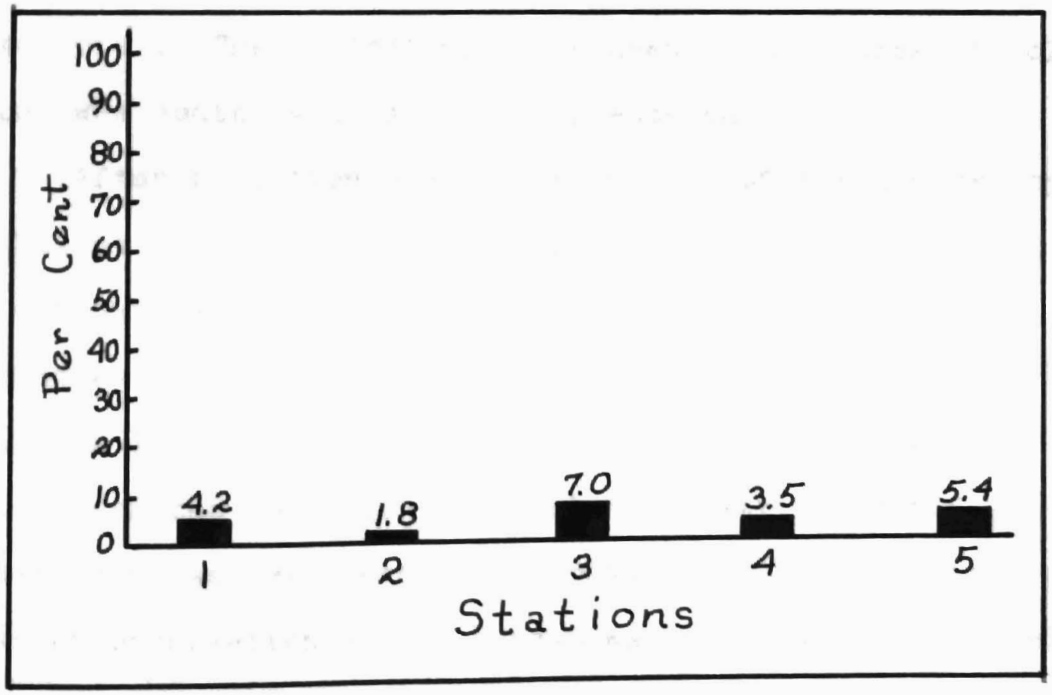

Figure 8 B. Percentage of total minnows collected at each station that were of the species. Pimephales promelas.

breeding-tubercles across their snout, indication that the fathead minnows were spawning at the upper stations on the stream. At stations 1 and 2 not fathead minnows were collected during the 15 following weeks. At stations 4 and 5 fathead minnows were taken in later collections. As shown in Figure 7 B, page 22, the fathead minnow composed a very small per cent of the total minnows collected at any of the stations. At station 3 the fathead minnow was most abundant, making up 7% of the total number of minnows collected here.

On the 20th of August 1960 pollution from a corn processing plant was noticed in the creek. The normally clear water was a milky color. Odor from the decaying material in the water was very noticeable. The rocks and other materials on the stream bottom became slippery with a slimy covering of material. The collecting seine used in this area of pollution was coated with slime after each haul.

After pollution occurred reduction of the minnow population at station 1 and 2 was observed, see Table I. After the minnows decreased at station 1 and 2 areas, the number of minnows collected at stations 3 and 4 increased. A reduction in minnows at station 4 in collections 13-16 resulted from the low water level at this station in the fall. No dead minnows were observed as result of the pollution but constant observation of the stream was not made. Published

TABLE I

TOTAL NUMBER OF SIX MAJOR SPECIES OF MINNOWS COLLECTED AT EACH STATION ON GRIMES CREEK, GRIMES, IOWA FROM THE 13 OF AUGUST 1960 TO 26 OF NOVEMBER 1960

16 WEEKLY COLLECTIONS	STATIONS				
	1	2	3	4	5
1.	7	36	71	15	22
2.	465	68	20	7	7
3.	7	0	13	14	59
4.	18	0	10	15	4
5.	2	0	78	88	27
6.	1	4	49	93	61
7.	3	2	8	32	28
8.	0	2	42	65	33
9.	0	0	26	14	18
10.	0	0	12	11	39
11.	0	7	28	15	19
12.	0	0	57	13	28
13.	0	0	12	0	5
14.	0	0	48	0	1
15.	0	0	23	0	10
16.	0	0	16	0	55

information on stream pollution in relationship to minnow populations in small streams is not known to this investigator.

The creek chub apparently successfully spawns in the areas of station 1 and 2. Four-hundred and eleven creek chubs were taken in one seine haul at station 1 after pollution by the canning factory at Grimes had begun. Over 400 of these creek chubs were young of the year. Early arrival of the creek chub apparently allows the young time to mature before the fall pollution from the canning factory occurs.

The bluntnose minnow is apparently limited in numbers in Grimes Creek due to failure to spawn successfully at stations 1 and 2. Spawning in the early fall months is inhibited by the stream pollution. The fathead minnows in collection 2 seemed to indicate by the breeding tubercles on the males and eggs in the females that they were going to spawn in this area of station 1 and 2. In later collections young of these two species were taken in very small numbers at stations 3, 4, and 5.

Burton and Oldum[1] found in a study of fishes in a rapid flowing stream a definite longitudional succession of species occurred. They found that this succession could be broken by a change of conditions. A definite longitudinal

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[1]G. W. Burton and E. P. Odum, "The Distribution of Stream Fish in the Vicinity of Mountain Lake, Virginia," Ecology, XXVI (March, 1945), 182-93.

distribution of minnows occurred in Grimes creek. The creek chub was found to be dominant in numbers at stations 1 and 2. At station 3 the bigmouth shiner was most numerous. The sand shiner was dominant at station 4 and the spotfin shiner at station 5. This longitudional succession of minnows remained constant during the collecting period except at the pollution area and areas of low water in the late fall.

CHAPTER V

SUMMARY

A study of minnow population of Grimes Creek near Grimes, Iowa, was made and their response to stream pollution by a canning factory located in Grimes, Iowa

Grimes creek was found to contain several species of minnows. The distribution of these minnows varied with certain species being predominant each of the five collecting stations.

The bigmouth shiner (Notropis dorsalis) was the most abundant species. This minnow was found primarily at the lower end of the stream and escaped the stream pollution which the headwater species encountered at stations 1 and 2.

The creek chub (Semotilus atromaculatus) made up 24.0% of the total number of minnows collected. This species apparently spawns successfully in the upper reaches of Grimes creek. Four-hundred and eleven creek chubs were taken in one seine haul at station 1 after pollution by the canning factory at Grimes had begun. Over 400 of these creek chubs were young of the year. The early spawning of the creek chubs might be the reason that they are the dominant species at station 1 and 2.

The sand shiner (Notropis deliciosus) composed 14% of the total number of minnows collected. This species was

found at the lower end of the stream and apparently was not affected by pollution of the stream.

The spotfin shiner (Notropis spilopterous) accounted for 13.0% of the total number of minnows collected. This species was found primarily at the lower stations and escaped the serious pollution problem at the upper station.

Grimes creek has a very large minnow population and is an important feeder stream into Beaver Creek during the fall and winter months. The adult creek chubs apparently move into Grimes creek early to spawn which was indicated by the large numbers of young seined at station 1 and 2. Later spawning minnows, such as the bluntnose and fathead minnows, apparently fail to spawn successfully in Grimes Creek as indicated by the absence of these two species in most collections.

The oxygen content of the water in Grimes creek was not taken. The depletion of oxygen by the decomposing wastes could be a possible factor in the minnow movement out of the headwaters of the stream. This problem needs further investigation.

A study of the creek bottom would lend additional evidence to food habitats of the minnows in Grimes creek and also provide interesting study during the pollution period in the fall.

The Grimes creek area affords an ideal region to study relationship of the minnows to their small creek environment

and stream pollution, and work should be continued in successive years.

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C. OTHERS

Map, Supervisors Districts (1-5), Polk County, Iowa.